

PSYCHE.

THE IDENTITY OF THE SNOW-FLEA (*ACHORUTES NIVICOLA* FITCH).

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Under the term "snow-flea," several species of *Achorutes* have been badly mixed. The original description of *A. nivicola* Fitch is apparently broad enough to entitle three distinct species to the name of "snow-flea," and to make it rather difficult to determine which species Fitch meant. Considerable attention to the subject, however, has enabled me to identify his species to my own satisfaction, and, I hope, to that of other students, because the synonymy of the snow-flea concerns not only our American forms, but also involves certain European species.

The original description of *nivicola* is becoming inaccessible, but is reprinted in full below, from my copy of Fitch's "Winter Insects of Eastern New York" (1847), and the entire paper has been republished in Lintner's Second Report.

Podura nivicola. "THE SNOW-FLEA."

Black or blue-black; legs and tail dull brown.

Length 0.08.

Body black, covered with a glaucous blue-black powder but slightly adherent, and sparingly clothed with minute hairs; form cylindrical, somewhat broader towards the tail. Antennae short and thick, longer than

the head. Legs above blackish, beneath dull brown and much paler than the body. Tail of the same color with the venter, shortish, glabrous on its inner or anterior surface, with minute hairs on the opposite side; its fork brownish.

Though found in the same situations as the European *P. nivalis*, ours is a much darker colored species. Say's *P. bicolor* is a larger insect than the one under consideration, and differs also in size and in the color of the tail or spring. From the habits of the present species, we should infer that it might be abundant in all the snow clad regions of the northern parts of this continent; it may therefore prove to be identical with the *P. humicola* of Otho Fabricius (*Fauna Gröenlandica*), of which we are unable to refer to any but short and unsatisfactory descriptions, which do not coincide well with our insect.

This is an abundant species in our forest, in the winter and fore part of spring. At any time in the winter, whenever a few days of mild weather occur, the surface of the snow, often, over whole acres of woodland, may be found sprinkled more or less thickly with these minute fleas, looking, at first sight, as though gunpowder had been there scattered. Hollows and holes in the snow, out of which the insects are unable to throw themselves readily, are often black with the multitudes which here become imprisoned. The fine meal-like powder with which their bodies are coated, enables them to float buoyantly upon the surface of water, without be-

coming wet. When the snow is melting so as to produce small rivulets coursing along the tracks of the lumberman's sleigh, these snow-fleas are often observed, floating passively in its current, in such numbers as to form continuous strings; whilst the eddies and still pools gather them in such myriads as to wholly hide the element beneath them.

Fitch's types of *Collembola* are not known to exist, so Dr. Felt wrote me. Fitch's manuscript notes on the order, which belong to the Boston Society of Natural History, I have read and copied, thanks to Mr. Samuel Henshaw; they correct the original description thus: "The antennae and legs are the same color as the body, not reddish or deep brown." (Fitch appears to have had *Podura aquatica* in mind, in the first instance.) He adds, "In the early spring the buckets and troughs of the manufacturer of maple sugar are often thronged with these insects."

Although the description of *Podura nivicola* is less specific than is desirable, and has consequently been the source of some confusion,—nevertheless, the evidence which I have collected leaves no reasonable doubt in my mind, as to the identity of Fitch's species.

Three species (here called *nivicola*, *harveyi*, and *packardi*) have been and may be confused, on account of their superficial agreement in form and color, — and only three have any claim to the name of *nivicola*. These three are not only sharply separated by structural details, but are also so different in time of appearance, abundance, habitat, and habits that they can be determined in

the field. The form that I have re-described as *nivicola* is the only one that agrees with the original description in being abundant at any time during the winter,—and it may be depended upon to occur in immense numbers every year, in the manner described by Fitch.

Harveyi seldom appears before the first of March, in Massachusetts, where it occurs on the trunks of pine and other trees in but moderate numbers. I have it as a "snow-flea" from Maryland, but have never been able to find it as such in Massachusetts, Maine, or New York. Specimens collected for me in a sugar camp in Maine, for the purpose of this discussion, proved to be what I had called *nivicola*. Finally, Mr. MacGillivray, in response to my request, sent me "snow-fleas" from Osceola, Penn., and Otto, N. Y., saying, "The one from Otto, N. Y., is the common New York species." Both lots consisted of the species that I had already regarded as the real *nivicola*.

Packard's redescription of *nivicola*, which subsequent writers have substituted for Fitch's diagnosis, cannot apply to the *nivicola* established above, on account of the disagreement as to mucrones and anal spines; moreover, *nivicola* has disappeared from Salem and vicinity by May 7, at the latest,—while Packard gives May 28 and June 6 as two of his three dates. It does not apply to *harveyi*, for that does not occur much after April 12, except in the egg. Only one species remains to which it might, and does, apply. Packard's specimens of *nivicola* are lost, unfortunately, but

among some unpublished figures (which he kindly gave me), of his Essex County species, are camera-lucida drawings of every essential detail (claws, mucrones, anal spines, etc.) of his *nivicola*, a form with which I am familiar, and one that cannot be the *nivicola* of Fitch, on account of appearing too late, if for no other reason. The species which Packard called *nivicola*, is new and is here named *packardi*.

Lintner repeated Fitch's account of *nivicola*, supplementing it with Packard's description, upon the assumption that the two descriptions referred to the same species, and added several notices by others upon the occurrence of "snowfleas." Later, Dr. Lintner ('96, pp. 251 to 252) found that doubt attended the name of *nivicola*, and, still assuming that Packard's redescription was valid, figured a form from Ghent, N. Y., which agreed with it; this form is actually that which Packard described as *nivicola*, as I have learned from some of the original Ghent specimens, which were sent me by Dr. Felt. The *Schoturus nivicola* of Lintner's Eleventh Report, then, is *Achorutes packardi* n. sp.

The same report (pp. 253 to 254) contains the description of *Achorutes diversiceps* Lintn. The types of *diversiceps*, that were loaned to me by Dr. Felt, confirm my conclusion, drawn from Lintner's description and figures, that *diversiceps* is the form that Fitch named *nivicola*.

Harvey ('93, pp. 183, 184), without questioning the applicability of Pack-

ard's redescription, gave two full form figures to supplement Packard's account. I now have the specimens from which those figures were made, and find them to be Packard's species, indeed, and, therefore, not the *nivicola* of Fitch.

The queried references in the synonymy below are to popular notices upon insects that are probably, but not unquestionably, the snow-flea described by Fitch.

A. nivicola Fitch occurs in Europe under the names *socialis* Uzel and *spinifer* Schäf. Three Swedish examples of *socialis* which were determined by Schött and sent me by Schäffer, agree accurately with our *nivicola*. Schött ('94, p. 82), in fact, adds to his detailed account of *socialis*, "Es ist nicht unwahrscheinlich dass die von Packard beschriebene *Achorutes nivicola*, die er meiner Ansicht nach aus guten Gründen mit Fitch's *Podura nivicola* gleichstellt, keine andere als obige Art sei." This surmise, incorrect as to the supposed equivalence of Packard's and Fitch's species, is correct as regards the identity of *socialis* Uzel and *nivicola* Fitch.

I sent American specimens to Dr. Schäffer, who replied, "*Achorutes nivicola* Fitch erweist sich in den Formmerkmalen mit meinem *Achorutes spinifer* übereinstimmend. *Ach. spinifer* ist darnach eine (kleinere) Farbervarietät von *A. nivicola* Fitch."

A. nivicola is closely allied to *A. harveyi* n. sp., from which it may be separated by its stout superior claws, ovate inferiors, small anal spines on a

cylindrical segment, and clothing of long subequal setae.

Each of the three species discussed above is characterized below. Unless otherwise specified, the material referred to was collected by the author, and is owned by him; examples of each species, however, have been given to the Museum of Comparative Zoölogy, Cambridge, Mass.

Achorutes nivicola Fitch.

(Figs. 1-11.)

Podura nivicola Fitch, Amer. Journ. Sc. Agric., vol. 5 (1847) pp. 283-284 and vol. 6 (1847) p. 152; Winter Ins. E. N. Y. (1847) pp. 10-11 (reprinted by Lintner, Second Rept. (1885), pp. 204, 205, 244. Fitch, Rural New Yorker, vol. 8 (1857). ? McMinn, Proc. Acad. Nat. Sc. Phila., vol. 4 (1849) p. 246. ? Ashton, Proc. Ent. Soc. Phila., vol. 1 (1861) p. 32 (repr. Lint. Sec. Rept., p. 204). ? Walsh, Riley, Amer. Ent., vol. 1 (1869) p. 188. ? Field and Forest, vol. 2 (1877) pp. 14~~5~~-14~~6~~ (repr. Lint. Sec. Rept., p. 205).⁵₆

Achorutes socialis Uzel, Thys. Boh. (1890) pp. 69-70, tab. 2, figs. 16-19. Schött, Syst. Verb. (1894) pp. 81-82, taf. 7, figs. 6-8. Schäffer, Coll. Hamburg (1896) p. 172.

Achorutes nivicola MacGillivray, Can. Ent., vol. 23 (1891) p. 274.

Schoturus nivicola MacGillivray, Can. Ent., vol. 25 (1893) p. 316. Dalla Torre, Gatt. Arten Apt. (1895) p. 13.

Achorutes spinifer Schäffer, Coll. Ham-

burg (1896) pp. 172, 174, taf. 3, fig. 51.

Achorutes diversiceps Lintner! Eleventh Rept. (1896) pp. 253-254, figs. 23-25. (Ref. to Country Gentleman, Mar. 22, 1879, p. 327.)

Dark indigo blue throughout (fig. 1). Eyes (fig. 2) sixteen. Postantennal organs (fig. 3) of four elements. Antennae (fig. 4) almost as long as the head, with segments as 7:9:10:15; basal segment subglobose, second and third subcylindrical, fourth rounded conical. Body elongate, abdomen subfusiform, last segment cylindrical. Superior claws (fig. 5) stout, slightly curved, unidentate two fifths from the apex; inferior claws half as long, basally subovate, apically acicular; one long tenent hair with a minute knob; distal tibial hairs minutely knobbed. Manubrium as long as the rest of the furcula; dentes (figs. 6, 7) stout, subcylindrical, apically broad and rounded, bearing four to six prominent, acutely conical teeth, of which one is more lateral than the others; in addition, there are usually fifteen to seventeen small outer teeth; mucrones (fig. 8) inserted on inner side of the apex of each dens and rather boat-shaped; in profile, suboblong, feebly curved, apex retuse or emarginate. Anal spines (figs. 9, 10) two, small, conical, erect, upon low, separated papillae. Clothing (fig. 11) of numerous long curving hairs and few short curved setae. Length, 2 mm.

Norway, Maine, May 7, F. Howe, Jr.; Orono, Maine, March, April 15, May 6, F. L. Harvey. Arlington, Massachusetts, April 12, Belmont, Massachusetts, April 19, May 5; Winchester, Massachusetts, February 9, R. W. Hall; Karner, New York, April 26, J. A. Lintner (N. Y. State Coll.); Otto, New York, J. H. Comstock; Osceola, Pennsylvania, A. D. MacGillivray.

Achorutes packardi sp. n.

(Figs. 12-18.)

Achorutes nivicola Packard, Thys. Essex Co. (1873) pp. 29-30. Lintner Second Rept. (1885) p. 203. MacGillivray, Can. Ent., vol. 23 (1891) p. 274. Harvey! Ent. News, vol. 4 (1893) p. 183, figs. 5, 6.

Schoturus nivicola Linnner! Eleventh Rept. (1896) pp. 251-252, figs. 21, 22.

Dark indigo blue throughout. Eyes (fig. 12) sixteen. Post-antennal organs (figs. 13, 14) of four elliptical-oval elements. Antennae shorter than the head, with segments as 5:8:7:10; basal segment globose, second and third slightly expanding, fourth subcylindrical with rounded apex. Body subcylindrical. Superior claws (fig. 15) broad, almost straight, untoothed; inferior claws of hind feet two fifths as long as the superiors, slender, lanceolate, acuminate; of the remaining feet, one fourth as long, small; tenent hair stout, exceeding the large claw, apex bent. Manubrium as long as the rest of the furcula; dentes (fig. 16) one sixth as long, oblong, distally rounded, terminating in an upturned tooth. Anal spines (fig. 17) two, three fifths as long as a superior claw, stout, feebly curved, erect; upon contiguous papillae. Clothing (fig. 18) of many stout curving serrate setae of moderate length and fewer long erect capitate setae, more or less serrate. Length, 2 mm.

This is the species that Packard redescribed as *nivicola* Fitch. Packard's specimens are not in the Museum of Comparative Zoölogy, with the rest of his Essex County material, but I am in possession of his original drawings, which leave no doubt as to what species he regarded as *nivicola*. Harvey and

Lintner depended upon Packard's account of *nivicola*, and the specimens to which they applied that name are, indeed, the same species that Packard had in hand; this I have learned from an examination of the identical specimens that Harvey and Lintner used in preparing the papers mentioned above in the synonymy.

As I have good reasons (already given) for believing that the *nivicola* of Packard is not that of Fitch, and needs a new name, I gladly name it *packardi*.

Toronto, Ontario, June 26, R. J. Crew; Orono, Maine, February, F. L. Harvey; Cambridge, Massachusetts, April 17; Lexington, Massachusetts, May 10, 11; Ghent, New York, April 13, E. C. Powell (N. Y. State Coll.); Newark, Maryland, January 24, Beckwith (N. Y. State Coll.).

This species is frequently found on red maple trees, crawling on the trunk or remaining under the bark or in crevices, especially about the base of a tree. I have occasionally found it under the bark of pine, oak, and apple trees, or about the roots; or clustered under moss on a stone. Full grown individuals occur from mid April until the middle of June; a second brood begins to appear late in June and has disappeared by the last of August. I have twice (April 22, 29) found abundant eggs of this species under the loose moist bark of red maple roots, protected by the sod; they were pale yellow, spherical, 135 micra in diameter, occurred in irregular masses and hatched in a little under one month.

Achorutes packardi, var. *dentatus*, var. n.

(Figs. 19-24.)

In this variety all the superior claws (fig. 19) are unidentate, the mucrones (figs. 20, 21) are one fourth as long as the dentes, slender and laterally lamellate, the anal spines (fig. 22) are slender, while the stout erect setae are either not capitate (fig. 23), or else are obscurely capitate on the posterior part of the abdomen (fig. 24). In all other respects the variety agrees with the typical form.

Orono, Maine, March 10, 15, May 11, F. L. Harvey; Arlington, Massachusetts, April 10, 13, 23, 30, May 23, September 10; Ghent, New York, April 13, E. C. Powell (N. Y. State Coll.).

This variety lives under the loose bark of pine, red maple, and oak trees, especially at the base of the roots, and sometimes occurs on snow. It has at least three broods, which mature at intervals of six or seven weeks.

Dentatus is a seasonal variety of *packardi*. Young individuals that hatched May 20 from eggs laid by the variety *dentatus* were not that variety, but were the typical form, with bulbiferous setae, no teeth on the superior claws, and with lamellate mucrones. One of the four specimens from Ghent, N. Y., was the variety *dentatus*, the others being the typical form.

This is the first record of seasonal dimorphism among the Collembola, although I suspect that certain other species also assume disguises, according to the season in which they occur. This

can be proved, however, only by careful breeding experiments, which are difficult to conduct accurately with these insects.

Achorutes harveyi sp. n.

(Figs. 25-34.)

Dark indigo blue throughout. Eyes (fig. 25) sixteen. Postantennal organs (figs. 26, 27) of four elliptical-oval elements. Antennae (fig. 28) subequal to the head in length, with segments as 10:13:13:20; first two segments subclavate, last two subcylindrical. Body elongate, abdomen subfusiform. Superior claws (fig. 29) slender, tapering, slightly curved, unidentate about one third from the apex; inferior claws less than half as long, basal half suboblong, apical half acicular; one long tenent hair with bent apex. Manubrium as long as the rest of the furcula; dentes stout, subcylindrical, apically broad and rounded, projecting beyond the bases of the mucrones, bearing two rows of teeth (fig. 30), fourteen to twenty-five in number, which are variable in size, and are more or less confluent basally; five may be much larger than the others (fig. 31), and sometimes no teeth are present; mucrones (fig. 31) one fourth as long as dentes, in profile suboblong, dorsally concave, apically emarginate. Anal spines (figs. 32, 33) two, long (almost as long as a superior claw), slender, feebly curved, upon prominent approximate papillae. Clothing (fig. 34) of numerous curving setae and fewer bowed hairs. Length, 2 mm.

This species is much like *nivicola*, but differs chiefly in having slender superior claws, suboblong inferiors, long anal spines, and clothing of another type.

Orono, Maine, F. L. Harvey; Arlington, Massachusetts, January 16, March 1, 10, 20, April 8, 9, 12; Annapolis, Maryland, January 15, C. E. Munroe (M. C. Z.).

This species occurs, long before snow has gone, in large colonies, under loose wet bark and under soil, in crevices at the base of a tree. Although most common on pine, it lives also on elm and apple. In mild weather, it wanders about on the trunks of trees or on the ground, and it occurred in enormous numbers as a "snow-flea," in Maryland, as recorded above. Captive specimens laid eggs between April 9 and April 13.

On April 12, I found abundant eggs of this species among a colony of adults at the base of a white pine; the eggs were white, spherical, and deposited in irregular heaps.

I have never been able to find this species in its customary haunts at any time of the year after April 12; it is probably at least digoneutic, however, and may prove to be dimorphic.

ON THE LIMITS OF THE FAMILY SATURNIIDAE, WITH A NOTE ON THE GENUS ROTHSCHILDIA.

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The elimination of so many non-spinning genera from the Saturniidae as proposed in this paper leaves that family very much curtailed.

As I pointed out some years ago,* it is divided into two subfamilies, of very simple larval characters, i. e., whether the two dorso-median tubercles of the 8th abdominal segment of the larva remain separate, or are united in a single median one.

The subfamily Saturniinae, characterized by having six separate tubercles (the two median ones being separate) on the 8th abdominal segment, comprise the following genera, *Perisomena*, *Cricula*, *Saturnia* (I cannot see that *Calo-*

saturnia mendocino differs from *Saturnia*), *Heniocha*, *Loepa*.

The subfamily *Attacinae* was at the same time characterized by the larvae having but five tubercles on the 8th abdominal segment, the median one being double, resulting from the fusion of the tubercles belonging to the two dorsal series. The imaginal characters bear out this arrangement.

The following genera belong to this group, beginning as heretofore with the most generalized forms, the exact sequence being subject to farther modification: *Copaxa*, *Opodiptera*, *Tagoropsis*, *Syntherata*, *Rhodia*, *Rinaca*, *Neoris*, *Caligula*, *Graellsia*, *Argema*, *Actias*, *Tropaea*, *Antheraea*, *Telea*, *Metosamia*, *Callosamia*, *Samia*, *Epiphora*, *Philosamia*, *Rothschildia*, *Coscinocera*, *Attacus*.

* Studies on the transformation of moths of the family Saturniidae. Proc. Amer. Acad. Arts and Sciences, Boston, (n. s.) XX, p. 58. 1893.